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# Beechcraft

PROTOTYPE DEVELOPMENT  
MODEL 385 AIR REFUELING STORE

May 14, 1963

Prepared Under Navy, Bureau of Naval Weapons

Contract NOW 60-0060-c

Interim Report No. 35

Engineering Report 4741

1 April 1963 Through 30 April 1963

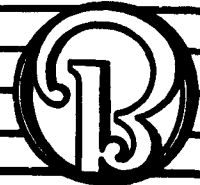
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BEECH AIRCRAFT CORPORATION

WICHITA 1, KANSAS, U. S. A.





# Beech Aircraft Corporation

Wichita, Kansas

PROTOTYPE DEVELOPMENT  
MODEL 385 AIR REFUELING STORE

May 14, 1963

Prepared Under Navy, Bureau of Naval Weapons  
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Interim Report No. 34

Engineering Report 4741

1 April 1963 Through 30 April 1963

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# Engineering Report

Engineering Report 4741  
May 14, 1963

## ABSTRACT

Activity during the month of April, 1963, in the development of the Beech Model 385 Air Refueling Store has consisted of duplication of reported deficiencies encountered on flight test, on ground test, and corrective reworks.

Test results prove that the store did not function as intended during flight tests. It has been found that the coupling required excessive force for engagement, and that the fuel pressure in the hose resulting from pressurization against a partially open but not fully engaged coupling stiffened the store hose excessively and to the extent that all response power was lost.

The coupling manufacturer has agreed to correct the coupling deficiency and the excessive hose stiffening under pressure was corrected by restoring the lubrication of the hose which was removed to accomplish hose marking.

The store will be ready for return to flight test when a satisfactory coupling has been received and tested.



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## STATEMENT OF WORK (1 April Through 31 April 1963)

Revisions to the flight test article were accomplished during this period after extensive duplications of flight test conditions on a ground test stand.

A cable tensioning system was installed on both the "boom lift" and "retract" cables. These systems are similar to the previously installed "floating pulley assembly". The tracks, supports and structural ties of the cable tensioners are physically similar or identical to the previously used floating pulley assembly.

Tests of the installed tensioning system show that the temporary slackening of either cable does not cause the cables to foul the cable drums.

This revision should prevent the difficulties encountered with the store at speeds above 275 K, when the cables fouled the cable drums, preventing normal retraction.

The ground tests showed that the coupling was not performing as intended.

It was assumed that the coupling would engage the probe nozzle with a maximum force of 140 pounds with 0 to 10 psi in the hose, as required by MIL-C-2516B, paragraph 3.9.3.1. Tests of a new coupling, purchased to replace the coupling damaged at Patuxent during the recent tests show the following: (All tests run at 0 fuel pressure.)

- Test #1 - Probe Nozzle "A" - 325 Lb. Coupling Force
- Test #2 - Probe Nozzle "A" - 180 Lb. Coupling Force - Coupling Rotated from Test #1
- Test #3 - Probe Nozzle "A" - Over 400 Lb. Coupling Force - Coupling Rotated from Test #2
- Test #4 - Probe Nozzle "A" - Over 400 Lb. Coupling Force - Coupling Rotated from Test #3
- Test #5 - Probe Nozzle "A" - 258 Lb. Coupling Force - Coupling Rotated from Test #4
- Test #6 - Probe Nozzle "A" - 182 Lb. Coupling Force - Coupling Rotated from Test #5
- Test #7 - Probe Nozzle "A" - 230 Lb. Coupling Force - Coupling Rotated from Test #6
- Test #8 - Probe Nozzle "B" - 230 Lb. Coupling Force
- Test #9 - Probe Nozzle "B" - 206 Lb. Coupling Force - Coupling Rotated from Test #8
- Test #10 - Probe Nozzle "B" - 230 Lb. Coupling Force - Coupling Rotated from Test #9



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### STATEMENT OF WORK (Continued)

Tests were then run on the coupling used during the Patuxent tests with the following results:

Test #1 - Probe Nozzle "A" - 164 Lb. Coupling Force  
Test #2 - Probe Nozzle "A" - 158 Lb. Coupling Force - Rotated from Test 1  
Test #3 - Probe Nozzle "A" - 142 Lb. Coupling Force - Rotated from Test 2  
Test #4 - Probe Nozzle "B" - 166 Lb. Coupling Force  
Test #5 - Probe Nozzle "B" - 166 Lb. Coupling Force - Rotated from Test 4  
Test #6 - Probe Nozzle "B" - 166 Lb. Coupling Force - Rotated from Test 5

The probe nozzle designated as "A" above was also shipped to the coupling manufacturer for his inspection and use to check the coupling.

The store performance was noticeably affected by the high coupling forces and fuel transfers could not be accomplished to the ground vehicle as intended, even with closure rates in excess of 15 feet per second.

Further research into the degradation of the store performance under these conditions showed a stiffening of the hose due to fuel pressure far in excess of that previously experienced.

Graph #1 shows the stiffness of the hose with and without pressure in terms of response power and response distance. The dashed lines show the hose as flown at Patuxent, and the solid lines show the same hose after application of a dry film lubricant over one-half of its length.

The explanation for the loss of response power at Patuxent appears to be as follows.

The hose manufacturer had lubricated the component parts of the metal hose during manufacture of the hose and allowed the lubrication to remain as corrosion protection. This lubrication is not in evidence except to soil the hands when working with it for some time; however, it prevented marking the hose as requested by the preceding Patuxent flight test report until it was thoroughly degreased and etched. It was not considered significant to restore the manufacturers lubrication of the hose until the data shown on graph #1 was obtained.

When the existing factors of high coupling force, stiffening hose and starting of the pump at the 17 foot point of the graph are considered simultaneously, it is apparent that the coupling did not engage as planned and the fuel pump started against the blocked hose.



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### STATEMENT OF WORK (Continued)

The blocked hose stiffened under nearly 200 psi fuel pressure, reducing the response power of the store to the unacceptably low level shown on the bottom line of chart #1.

By the same reasoning, it is logical to expect that the restoration of the lubrication on the hose, a slight change in spring rate of the drag strut, and a rewiring to start the pump after 20 gpm fuel flow is established will correct the response power deficiency.

The spring rate change is accomplished by removing the oil from the drag strut, which served only to reduce air volume. The drag strut oil was used to accomplish a slight reduction in response power as response distance is decreased in order that the coupling will engage more readily in the event that initial impact did not effect engagement. It is apparent that the hose stiffening effect will accomplish this objective, and the drag strut oil is not needed.

The rewiring change consists of using the signal from the flowmeter, which now turns on the green light, to also turn on the pump. The gravity feed capability of the store is far in excess of 20 gpm, therefore, it appears logical to use the pump only when flow in excess of 20 gpm is required, thereby helping to insure that a coupling has been accomplished before the pump pressure makes coupling difficult or impossible due to increased coupling forces required under pressure.

The store drogue has also been modified by reducing the length of the drogue leaves approximately 2 inches to prevent their striking the F8U probe support.

Flight tests are being conducted at this time on the modified drogue which prove that the drag lost due to trimming the leaves can be restored by adding sheet metal drag producers to the drogue leaves.

A final configuration has not yet been established but is not expected to delay the Patuxent test program. Sufficient data has been obtained to allow the store to be shipped without the drogue.

It is expected that the store will be shipped the week of May 13th, and the drogue shipped separately approximately 2 weeks later, arriving at the Test Center at approximately the same time.



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### PROGRAM FOR NEXT MONTH

Development of the Beech Model 385 Air Refueling Store will continue during the month of May, 1963, and will be returned to the Test Center for additional flight tests.

Drawings for long lead time items for two additional stores will also be prepared during this month.